

APPENDIX II

THE PLAUSIBILITY OF NEGATIVE IMPACTS TO THE NEVADA VISITOR ECONOMY FROM A REPOSITORY AT YUCCA MOUNTAIN: A REVIEW OF THE EMPIRICAL LITERATURE

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A REVIEW OF THE EMPIRICAL LITERATURE**

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INTRODUCTION

Of all the negative impacts that might accompany a high-level nuclear waste (HLNW) repository at Yucca Mountain, the potential collapse of the southern-Nevada visitor economy looms as one of the most immediate and imaginable threats. During the year 2000, the Las Vegas metropolitan area attracted 35.8 million visitors who contributed \$31.5 billion to the local economy — through gaming, hotel stays, meals, transportation, etc. (Las Vegas Convention and Visitor Authority, 2001). The Yucca Mountain site is approximately 90 miles northwest of Las Vegas — close enough to tarnish the image of the city. Moreover, the current design for the repository calls for shipments of spent nuclear fuel to pass within view of the huge casino-hotel complexes along the Strip.

Elected officials in Nevada have long pointed to the possibility that the repository could adversely affect the local visitor industry. For example, then-Governor Richard Bryan cited this as a major concern in a 1987 journal article:

When one considers that tourist-generated revenues account for much of the tax base in Nevada and that tourism-related industries are the state's largest employers, any reduction in visitors could have catastrophic consequences (Bryan, 1987, p. 36).

Likewise, the Nevada attorney general cited the potential for losses to the visitor economy as a major rationale in a lawsuit designed to prevent the Department of Energy from proceeding with the characterization of the Yucca Mountain site [*State of Nevada v. Watkins*, 914 F.2d 1545 (9th Cir. 1990)].

Beginning in the mid-1980s, state officials have taken deliberate steps to assess the likelihood that such effects would occur and to document the risk with empirical evidence. In particular, using funding allocated to candidate states under the Nuclear Waste Policy Act of 1982, the Nevada Nuclear Waste Project Office (NWPO) contracted with Mountain West and a

national team of researchers in 1986 to conduct a comprehensive socioeconomic impact assessment of the proposed repository. Over the next decade, the research team carried out a host of inter-related studies using various methodologies and sampling frames to explore the possibility of impacts to the economy, as well as to social and individual well-being. These studies resulted in over 200 technical reports and 100 published articles (Chalmers et al., 1993).

On the basis of the research conducted by the Nevada Socioeconomic Study Team, an independent Technical Review Committee (TRC) concluded that:

The greatest potential socioeconomic difficulty of the proposed repository stems from the intense negative imagery associated by the public with a high-level radioactive waste repository, combined with the vulnerability of the Nevada economy to changes in its public image. Because of the high profile nature of the whole nuclear waste disposal program, the potential exists for Nevada to become associated with this negative imagery to the detriment of its attempts to attract tourists, conventions, migrants and new industry to the state (White et al., 1990, p. 4).

Despite the strength of evidence pointing to at least the possibility of repository-induced impacts to the Nevada visitor economy, the Department of Energy's (DOE) Yucca Mountain Draft Environmental Impact Statement (EIS) virtually ignored this class of impacts (DOE, 1999). In its formal response to the EIS, the State of Nevada argued that:

The fact that no assessment of "special" impacts to Nevada's uniquely vulnerable tourism-dependent economy was conducted in the draft EIS, despite DOE's prior knowledge of the potential for and legitimacy of such impacts, renders the socioeconomic impact assessments in the draft document both legally and substantively deficient (NWPO, 2000, Appendix I, p. 10).

The State's response to the EIS includes a cogent summary of the research evidence that supports the plausibility of visitor impacts (NWPO, 2000, Appendix I). A similar case is built in the Nevada Commission on Nuclear Projects' December 2000 report to the Governor and

Legislature (Nevada Commission on Nuclear Projects, 2000).

The current report extends those existing analyses by attempting to forecast, in a quantitative sense, the level of loss that could occur if an underground repository for HLNW were constructed and opened at Yucca Mountain. Because of the novelty of the proposed repository and the lack of truly comparable case studies, this forecasting task has so far proved both tenuous and contentious. Existing efforts to forecast visitor impacts have relied primarily on data collected from tourists, convention planners and convention attendees indicating what they would expect to do if a repository were located near their preferred destination (e.g., Slovic et al., 1991; Kunreuther, Easterling & Kleindorfer, 1988; Easterling, Morwitz & Kunreuther, 1990; Easterling & Kunreuther, 1993). Even though these analyses have acknowledged the substantial uncertainty involved in projecting future behavior from statements of intent, the work has been roundly critiqued by DOE researchers in professional journals (e.g., Bassett & Hemphill, 1991; Metz, 1994; 1996).

In order to provide more “defensible” estimates of visitor impacts, this analysis focuses much more on analogous cases as the data source. In particular, the approach presented here identifies the key characteristics of those risk events that have led visitors to avoid an area. The key analytic question is whether these past events (which are known to have produced visitor losses) have “plausible” parallels with regard to scenarios that could occur with a HLNW repository. To the extent that a parallel scenario can be constructed for the repository, the observed loss is a plausible estimate of what might occur in southern Nevada if a repository opens at Yucca Mountain.

THE POTENTIAL FOR VISITOR IMPACTS

Before proceeding to the review of the visitor-impact research, it is useful first to re-set the stage for the analysis. In particular, this section revisits the question of what is actually at stake when considering the prospects of repository-induced impacts to the visitor economy of southern Nevada. From there, we explore the question of how a repository could lead to visitor losses, as well as the face validity of these theories that hypothesize negative impacts.

What is at stake?

Nevada is unique among all the states in terms of its vulnerability to visitor impacts. According to a 1994 study, almost 40 percent of the state's labor force was employed in tourism-related jobs (e.g., hotels, casinos), more than double the rate of any other state and almost 10 times the national average (Edmonston, 1994). In the year 2000, over 35 million individuals visited Clark County, contributing \$31.5 billion to the local economy (Las Vegas Convention and Visitors Authority, 2001). These visitors included gamblers, tourists coming to visit the many entertainment venues in Las Vegas and attendees at conventions.

The extent to which the Clark County economy depends on visitors becomes even more clear when we compare the region with other major destinations across the country. For example, Clark County's \$31.5 billion in visitor contributions is approximately 25% higher than the \$25 billion figure for New York City in 2000 (Bagli, 2001), despite the fact that New York has over five times as many residents and a panoply of one-of-a-kind tourist attractions (e.g., the Statue of Liberty, Broadway).

Clark County's visitor economy is of the same order of magnitude as the visitor economy for the entire state of California (which is the home of such popular destinations as San

Francisco, Los Angeles, San Diego, Disneyland and Yosemite National Park). In 1997, California received 51.5 million people from outside the state (California Trade and Commerce Agency, 2001), compared to the 30.5 million persons who visited Clark County (Las Vegas Convention and Visitors Authority, 2001). If we express those figures as a ratio of visitors to population, we find that California had approximately 1.7 visitors for each of its 30 million residents, whereas Clark County had approximately 25 visitors for each of its 1.2 million residents.

It is also important to point out how much the visitor economy has grown in recent years. The total of 35 million visitors for 2000 is five times the 6.8 million visitors who came in 1970. As Figure 1 shows, the volume of visitors and their contribution to the economy has grown steadily over the past 30 years. Although visitation flattened off during a few periods in which the national economy was in recession (e.g., the late 1970s), these slumps were more than compensated by other years in which explosive growth occurred. In the last decade, lodging capacity increased by approximately two-thirds (from 76,500 rooms in 1992 to 126,400 rooms in 2001) with the construction of huge hotel-casino complexes along “the Strip” (e.g., Aladdin, Bellagio, Luxor, MGM Grand, Mandalay Bay, Paris, the Venetian) (CBER, 2001). Visitor volume also grew by two-thirds over the decade -- from 21 million in 1990 to 35 million in 2000. Going back over the entire past three decades, visitor volume has increased by an average of 5.5 percent per year (compounded over time).

As the visitor economy has expanded, its customers have changed markedly. No longer simply a gambling destination, southern Nevada now attracts families with children who are drawn to the “theme-park” environment of the new mega-hotels. In addition, with the construction of huge new exhibit halls, Las Vegas became the number-one convention

destination during the 1990s. In 1989, Las Vegas hosted 711 conventions which attracted 1.5 million delegates, placing Las Vegas 6th among U.S. cities in convention attendance (Business Travel News, 1990). However, ten years later, Las Vegas hosted 3,847 conventions which attracted 3.8 million delegates (Las Vegas Convention and Visitor Authority, 2001). As with the growth in overall visitor volume, this expansion of the convention segment of the market makes Las Vegas ever more dependent on the city's attractiveness as a destination for people who are deciding whether and where to travel.

In sum, the available data on visitor volume and dollar expenditures indicate that, more than anyplace else in the country, Clark County's economy depends on the willingness of out-of-state residents to come and visit.

Why Might a Repository Cause Visitors to Avoid Nevada?: Theories of Impact

Kasperson et al.'s (1988) "social amplification of risk" theory provided the initial framework for studying the economic impacts of a repository. This theory contends that a risk event (e.g., an accident involving a truck transporting spent fuel to the repository) gives rise to a flow of information (e.g., through the media), which has some influence on the behavior of many different groups of actors (e.g., the immediate victims, residents living near the facility, government officials, investors). Depending on how strongly these persons act, the event will have consequences that extend far beyond the organizations with a direct role in the event. For example, the accident at the Three Mile Island nuclear reactor inhibited the development of the entire nuclear industry and also brought increased public and governmental scrutiny to non-nuclear technologies (e.g., hazardous-waste landfills).

Researchers supported by NWPO have identified three more specific pathways through which a repository might lead visitors to avoid Nevada. First, areas near Yucca Mountain (e.g.,

Las Vegas) might be viewed as risky places to visit, which would cause people to avoid them. Second, repository-related images could become associated with southern Nevada, which might make the area a less attractive place to visit. Finally, under extreme circumstances (e.g., a series of fatal radiation accidents), southern Nevada might become widely viewed as a highly contaminated place, which could lead to *stigmatization* and extreme avoidance by persons outside the state.

The risk-avoidance model posits that repository-induced effects will occur as a result of the danger that becomes associated with the facility. Under this impact model, potential visitors will avoid coming to Las Vegas because they perceive a heightened level of risk to their health. The most obvious source of this risk would be a transportation accident involving nuclear-waste shipments occurring near their hotel. In addition, people might come to fear that the burial of wastes at the repository might contaminate the air or water as far away as Las Vegas. If the public comes to regard such a scenario as sufficiently likely (or if the scenario becomes sufficiently salient), visitors will avoid the affected areas in order to minimize their risk, at least according to this theory.

The risk-avoidance theory of visitor losses follows rather directly from the standard theories of self-protective behavior. For example, individuals are assumed to engage in behaviors such as buying insurance and wearing seat belts to the extent that they believe they are at risk (Slovic, Fischhoff, Lichtenstein, Corrigan & Combs, 1977; Weinstein, 1988). Indeed, one of the most established theories of health behavior — the Health Belief Model — places its major emphasis on the individual's sense of vulnerability to personal harm (Becker, 1974).

The second model in support of repository-induced effects relies on the construct of **negative imagery** (Slovic et al., 1991). Under this mechanism, it is assumed that the repository

will work its way into the "image set" of places in the vicinity. In other words, when people think of the prospect of visiting Las Vegas, the repository will become one of the images that comes to mind. The theory assumes that this image will be highly aversive for the typical individual, and as such, will reduce the decision maker's preference for visiting Las Vegas.

A number of studies have shown that a person's image of a place (either positive or negative) exerts a strong influence over the person's willingness to visit there. Slovic et al. (1991) surveyed residents from Phoenix and southern California, and found that visitor destinations such as Las Vegas evoke their own distinctive set of images (e.g., gambling, entertainment). Moreover, when these images are rated along a scale from "strongly negative" to "strongly positive," the resulting score predicts the individual's propensity to visit the place. In particular, individuals are less likely to visit a place the more negative its image score. A longitudinal analysis found that image scores collected at one point in time could predict actual visitation behavior over a subsequent 18-month period.

The predictive ability of imagery data has been replicated in studies conducted by other researchers. Jenkins-Smith (1994), with funding from DOE, employed a similar methodology and found a similar relationship between imagery and visitor preferences. In the convention attendees survey (Easterling and Kunreuther, 1993), the imagery score for a city was significantly related to the respondent's reported likelihood of attending a meeting in that city. Moreover, the effect of imagery remained significant even when controlling for attributes such as climate and recreation opportunities, indicating that imagery makes an *independent* contribution to visitor decision making.

The negative-imagery and risk-avoidance models represent complementary, but *independent* pathways for visitor impacts; the negative-imagery model allows for repository-

induced losses even in cases where the risk-avoidance model would not predict them. Namely, the imagery model holds that a person will avoid a place if a *noxious* image enters his or her mind at a critical point; images can be noxious without implying danger (e.g., dirty, evil).

The risk-avoidance and negative-imagery models each suggest that visitor impacts will become more pronounced if the repository is accompanied by serious accidents or heightened scrutiny on the part of the media. Under extreme circumstances, **stigmatization** might occur (Edelstein, 1988; Slovic et al., 1991; Gregory, Slovic, and Flynn, 1996, Flynn, Slovic and Kunreuther, 2001).¹ Southern Nevada would be *stigmatized* by the repository if the following three conditions occurred: (1) a large number of people felt an imperative to avoid the place, (2) this imperative stemmed from the sense that there was “something wrong” with that place, and (3) the sense of “something wrong” was represented by some sort of mark (Goffman, 1963; Jones et al., 1984; Edelstein, 1988; 2001; Slovic et al., 1991; Gregory, Slovic & Flynn, 1996).²

Just as persons infected with the AIDS virus are often ostracized on account of their illness, the repository could come to be viewed as contaminating nearby places, causing individuals outside the state to refrain from any contact. The possibility of stigmatization was raised by some farmers in eastern Washington state who feared that a repository at Hanford would lead consumers to refuse their produce (Dunlap, Rosa, Baxter & Cameron, 1993). In Nevada, the specific industry that is vulnerable to stigmatization is tourism/gaming/conventions rather than agriculture.

¹ Slovic et al. (1991) used the term “stigmatization” to cover both the negative-imagery and the stigmatization pathways.

² Avoidance behavior is not always indicative of stigmatization. For example, many people avoid visiting coastal areas such as Hilton Head and the Outer Banks of North Carolina during hurricane season, but still think very highly of these areas.

Las Vegas's Susceptibility to Visitor Impacts

In considering the possibility that a repository at Yucca Mountain could cause visitors to avoid southern Nevada, it is important to consider why people visit the area. In particular, Las Vegas attracts most of its visitors by offering gambling, entertainment, glitz and a carnival-like atmosphere. Most of the casinos, particularly the larger ones, are designed to allow visitors to escape from their mundane daily existence into a world of opulence or fantasy. In addition, many conventions are held in Las Vegas on account of the entertainment and diversions available in the city. Thus, many tourists and convention delegates will come to southern Nevada only so long as the area is attractive.³

The imagery associated with a HLNW repository (e.g., danger, poison, contamination, evil) is antithetical to the escapist view that the city seeks to project. If repository-laden images displace the city's current imagery, there is every reason to expect that many potential visitors will find other, more attractive destinations in which to spend their money.

The major unanswered question with regard to visitor impacts is whether the repository is a potent enough stimulus to displace the positive imagery that the public currently associates with Las Vegas. Based on surveys of thousands of people across the country, it is clear that the city's intended image (based on gambling, entertainment and glitz) is firmly embedded in most people's mind (Slovic et al., 1991; Easterling & Kunreuther, 1993; Jenkins-Smith, 1994). Some would argue that this imagery is so strong that the city is immune from the ill effects of a HLNW repository located 90 miles away (Jenkins-Smith, 2001). This might be true if the repository

³ Admittedly, some visitors to Las Vegas have less discretion over whether or not they come. In particular, many of the 3.8 million convention delegates will be "required" by their employers to attend the convention, and thus visit the city. Some of these conventions could conceivably be located in more desirable cities, but others (e.g., COMDEX) are so large that Las Vegas is one of the few cities that could accommodate the group.

turns out to be a benign presence on the public's mental landscape of Nevada. But if, through high-profile accidents, the repository becomes a prominent feature of that landscape, Las Vegas may also come to be defined by images speaking of danger and contamination.

It is also important to point out that Nevada is already somewhat stigmatized, at least among some people. A local columnist remarked that:

This state is the American home of nuclear weapons explosions, legalized gambling, upstanding gangsters, all-night carousing, legalized prostitution and the International Brotherhood of Elvis Impersonators. The Federal Government thinks so much of us it is going to build a nuclear waste dump here. All we need is a bad tie and goggle eyes and we are the Rodney Dangerfield of states (Reinhold, 1989, p. A10).

It is clear that some people associate attributes such as corruption, immorality and tackiness to places in Nevada, particularly Las Vegas. The city's existing image is somewhat tarnished, at least in some quarters. For example, in the survey of convention attendees described earlier (Easterling and Kunreuther, 1990), Las Vegas had the most negative image among the 12 cities tested; 19 percent of the sample rated Las Vegas's "overall image" as either "poor" or "unacceptable." Given that Las Vegas is at least part way toward stigmatization, a nearby repository might compound the effect.⁴

⁴ Jenkins-Smith (1994) argues that the repository will have little marginal effect in stigmatizing Las Vegas because of the correlation between views about gambling and views about nuclear waste. Namely, the type of person who holds that there is "something wrong" about a repository (i.e., environmentalists, "post-materialists") is the same sort of person who is already alienated by Las Vegas; adding the facility would simply reinforce their pre-existing avoidance behavior. In contrast, the individuals who are currently attracted to Las Vegas, and thus the ones whom the city can least afford to offend (i.e., conservatives, "fatalists") do not hold such negative views about a nuclear-waste repository, and thus seem unlikely to stigmatize Las Vegas in response to a repository at Yucca Mountain.

FACE VALIDITY OF THE ARGUMENT

The possibility of negative impacts to the visitor economy has certainly been credible enough to attract the attention of Nevada officials. However, others (especially representatives from DOE) have been highly suspect of the argument. This section of the report considers the plausibility of repository-induced visitor impacts according to individuals from a wide variety of perspectives.

Elected Officials in Nevada

Beginning in 1986 when the state first received funding to study the potential costs and benefits of a repository at Yucca Mountain, significant resources have been channeled into an assessment of socioeconomic impacts, particularly the possibility that visitors would avoid Las Vegas (Nevada Commission on Nuclear Projects, 2000). When the studies began to show evidence in support of visitor impacts, the executive director of the Nuclear Projects Agency, Bob Loux, was quick to highlight the risk (Vogel, 1988).

Over time, elected officials have become more and more opposed to siting a repository at Yucca Mountain, and correspondingly have been more and more explicit in citing the threat to the visitor economy as a key rationale (Swainston, 1991; Easterling and Kunreuther, 1995). Currently, Nevada's governor, attorney general, U.S. senators and U.S. representative are unified in their public statements about the possibility of negative impacts to the visitor economy. For example, U.S. Representative Selley Berkley argued that "the tourism industry can't afford the tarnish of a nuclear-waste disaster in its backyard. Just one accident could wreak havoc with our economy" (German, 2001).

Department of Energy

DOE's initial Environmental Impact Statement for the repository treats the possibility of visitor impacts as a non-issue – by neglecting to even mention the possibility. This omission could stem from one of two possible conclusions on the part of DOE:

1. Negative impacts to the visitor economy are such a remote possibility that there is no reason to address them in an EIS.
2. Visitor impacts might occur, but they would be confined to “irrational” responses to the threat of nuclear waste, which under the National Environmental Policy Act need not be acknowledged within an EIS (*Metropolitan Edison Co. v. People Against Nuclear Power*, 460 U.S. 766-779, 1983).

A more disingenuous interpretation of the omission is that DOE recognized the possibility and legal standing of repository-induced visitor losses, but simply did not want these impacts to enter into an assessment of the costs and benefits of building a repository.

At least publicly, DOE has claimed that the potential for visitor impacts is too remote to warrant their consideration in an economic analysis. For example, Carl Gertz, DOE's former project manager for Yucca Mountain, argued that a repository would have a negligible impact on the decisions of people who would otherwise visit Nevada, “We don't necessarily subscribe to the theory that things nuclear are going to hurt tourism” (Kerr, 1990, p. 18A). Similarly, Bill Metz, a consultant hired by DOE to study the possibility of economic impacts from the repository, concluded that, “historical evidence indicates nearby nuclear activities do not affect where individuals actually live, vacation, retire, and travel to conventions” (Metz, 1994, p. 764).

Officials in Other States Considered for Nuclear Waste Storage

The opposing predictions of visitor impacts on the part of Nevada officials versus DOE representatives is not surprising given their contrasting views on whether or not a repository should be built at Yucca Mountain. In considering the merits of Nevada's argument, it is interesting to consider what has occurred in other states that have been named as candidates to host nuclear-waste facilities. Almost without exception, the possibility of visitor losses has arisen as a major source of opposition. For example, when DOE proposed to build a Monitored Retrievable Storage (MRS) facility for nuclear waste in Oak Ridge, Tennessee, state officials raised objections that directly parallel Nevada's argument. In particular, Governor Lamar Alexander cited the possibility that an MRS "would impose a negative and economically harmful image on the area of Tennessee surrounding Oak Ridge" as one of two factors for opposing the project (Sigmon, 1987).

The possibility of tourism-related losses recurred time and again as the Nuclear Waste Negotiator solicited states, counties and Indian tribes to host an MRS in return for economic benefits. The County Commissioners in Fremont County, Wyoming received a grant to conduct a preliminary study of the feasibility of siting an MRS, but were prevented by Governor Mike Sullivan from pursuing the negotiation process any further. In his letter to the Commissioners, Sullivan asked the rhetorical question, "Who can assure us what risks we would accept that new businesses may chose not to locate in Wyoming or what the alteration of our image as a state, our environment or our tourism industry may be from our willingness to embrace this nuclear waste?" (Sullivan, 1992, p. 4). The director of the Wyoming Tourism Division suggested that these risks would indeed be much too high for the state

In this crazy business, we prefer not to deal with fighting perceptions. And I think that's what we would be up against: their fear of the unknown (Associated Press, 1995).

In almost precisely the same vein, Utah's Governor Michael Leavitt prevented San Juan County from engaging in further negotiations after its initial feasibility study. "I do not believe it is in the best interests of San Juan County or Southeastern Utah to accept an MRS facility. ... The tourism and recreation industries, which are highly important to San Juan County, would suffer significantly from the stigma of being what would be characterized nationally as a 'nuclear dumping ground'" (Leavitt, 1993, p. 1).

And in New Mexico, elected officials from the state and from the town of Ruidoso objected to a decision on the part of the Mescalero Apache Tribe to study the possibility of siting an MRS on the reservation. According to Wald (1993), "Many of the tribe's neighbors say a waste site could wipe out the economic base of nearby towns. 'Western tourism and nuclear storage don't mix,' said E. Frank Potter, a city councilman in Ruidoso." On the other hand, the Mescalero Apache's Tribal Chairman, Wendell Chino, argued that an MRS would not detract from the success of the reservation's tourist attractions: Inn of the Mountain Gods (a casino/outdoor sports complex) and Ski Apache (the second largest winter-sports operation in the Southwest) (Satchell, 1996). On the other hand, it should be pointed out that the only officials arguing that visitor impacts would not occur were those who were committed to seeing the facility built (similar to the case with the proposed repository at Yucca Mountain).

Media

Although it is difficult to establish whether or not the media regards a specific argument as "credible," the prospect of visitor losses has certainly garnered enough press coverage over the years to suggest that reporters and editors pay serious attention to the issue. This has included not only front-page coverage in Nevada's newspapers (e.g., Vogel, 1988; Kerr, 1990;

Manning, 1994), but also stories in the *New York Times* and other well-respected publications (e.g., Johnson, 1995).

On the other hand, a 1988 editorial in the *Las Vegas Review Journal* explicitly chastised Nevada officials for publishing reports claiming that a repository might lead to visitor losses:

It doesn't serve Nevada's purposes for the head of the state's Nuclear Projects Agency to drag out that old red herring about the proposed high level waste dump scaring off tourists. There are plenty of good reasons for Nevadans to object to the dump, but the tourism issue is not one of them. It's not a legitimate issue; it's a bugaboo of strictly political origins, and using it in the fight against the nuclear dump just detracts from the credibility of more valid concerns.

However, just recently the editor of the *Las Vegas Sun* wholeheartedly endorsed the argument that a repository at Yucca Mountain could lead to transportation accidents that would undermine the Las Vegas visitor economy:

I find it hard to believe that the industry or any other thinking Nevadans ... even need to be asked where they stand on this issue. ... The industry should have been leading the charge against the federal government's efforts to bury Nevada under the nation's nuclear garbage ever since it was first announced (Greenspun, 2001).

It is unclear whether there is that much difference between the two newspapers, or whether the risk of visitor impacts has become that much more plausible in the intervening 13 years.

General Public

If we look beyond elected officials and the media to the public at large, visitor impacts also arise as a critical concern, but there appears to be less certainty about the inevitability of these impacts. According to a series of telephone surveys summarized in Tables 1 and 2, a majority of the general public believes that it is "likely" that a nuclear-waste repository could

have negative impacts on the tourist economy of nearby places, although a sizeable fraction of individuals regard these impacts as “unlikely.”

Three samples of Nevada residents were polled between the spring of 1991 and the autumn of 1993 as to their belief that “the development of a high-level radioactive waste repository at Yucca Mountain could have a negative impact on the tourist and visitor economy in Nevada” (Flynn, Mertz & Slovic, 1991; Flynn, Slovic & Mertz, 1993; Flynn, Slovic & Mertz, 1994). Across the three surveys, the proportion agreeing with this statement varied between 52 percent and 62 percent (see Table 1). Correspondingly, between 30 percent and 39 percent of these samples of Nevada residents disagreed that a repository could negatively impact the state’s visitor economy.

Table 1
Belief Among Nevada Residents That “A High-Level Nuclear Waste Repository at Yucca Mountain Could Negatively Impact the Tourist and Visitor Economy of Nevada”

RESPONSE	Spring 1991 Survey	Spring 1993 Survey	Autumn 1993 Survey
Strongly Agree	43.2%	22.3%	22.9%
Agree	18.8%	30.3%	29.6%
Neither Agree/Disagree	8.4%	6.8%	4.3%
Disagree	14.2%	28.6%	28.0%
Strongly Disagree	15.4%	7.8%	11.2%
Don't Know/No Answer	--	4.1%	4.0%
<i>Sample Size</i>	<i>500</i>	<i>803</i>	<i>625</i>

Source: Flynn, Mertz & Slovic (1991); Flynn, Slovic & Mertz (1993); Flynn, Slovic & Mertz (1994).

Note: The scale for the Spring 1991 survey used “somewhat agree” rather than “agree,” and “somewhat disagree” rather than “agree.”

A somewhat different question was asked in three surveys conducted by Mertz, Flynn and Slovic in 1994. In particular, respondents in Nevada, southern California and Phoenix were asked, "What is the likelihood that a nuclear waste facility would cause tourists and other visitors to avoid coming to nearby communities" (Mertz, Flynn & Slovic, 1994; 1995). Among the 800 Nevada respondents, 62 percent believed that these impacts were either "likely" or "very likely" (see Table 2). Respondents in the two other surveys were even more inclined to expect that a nuclear waste facility would lead visitors to avoid nearby areas: 75 percent of the southern California sample and 76 percent of the Phoenix sample believed that such impacts were either "likely" or "very likely."

Table 2
Perceived Likelihood That "A Nuclear Waste Facility Would Cause Tourists and Other Visitors to Avoid Coming to Nearby Communities"

RESPONSE	1994 Nevada Survey	1994 Southern California Survey	1994 Phoenix Survey
Very Likely	27.8%	24.5%	34.5%
Likely	34.6%	50.9%	42.0%
Unlikely	27.5%	20.5%	19.3%
Very Unlikely	8.3%	3.3%	3.8%
Don't Know/No Answer	1.9%	0.9%	0.5%
<i>Sample Size</i>	<i>800</i>	<i>801</i>	<i>400</i>

Source: Mertz, Flynn & Slovic (1994), Mertz, Flynn & Slovic (1995).

A survey conducted under contract to DOE found somewhat lower levels of public endorsement of visitor impacts. In particular, Jenkins-Smith and Silva (1996) asked a sample of 2400 U.S. residents, "If it was widely known that radioactive materials were to be transported through your city or town, do you believe the number of tourists coming to your community

would greatly increase, increase, stay the same, decrease or greatly decrease?”⁵ This survey found that 56 percent of the public believed that the transport of nuclear waste through a community would decrease the number of tourists (including 16 percent who believed that the number would “greatly decrease”).

Potentially Impacted Businesses

Not surprisingly, concern over repository-induced visitor impacts is much greater among those individuals who have the most at stake – owners and employees of tourism-related businesses. This heightened concern is especially apparent in a study of the southern Nevada tourism industry conducted by Urban Environmental Research (UER) in 2001. Based on confidential interviews with 14 executives (representing 10 casinos and one industry association), the researchers concluded that:

It is clear that the gaming industry believes that the transportation of high-level waste (HLW) through Clark County would bring increased risk to the primary economic base for the entire state of Nevada. ... According to virtually every gaming industry representative interviewed, the most serious risk is from the stigma that will result if there is any accident of any kind involving the shipment of HLW. . These representatives referenced the media coverage (amplification) that is likely to accompany any accident with a nuclear waste vehicle. Several stated that an accident in Clark County would be reported worldwide, and it would be linked to Las Vegas because it is the nearest media outlet. While most of those interviewed were unsure as to the degree and duration of the stigma that would accompany an accident, virtually all indicated that it could be a serious problem. One senior gaming executive of a destination resort indicated that the media’s

⁵ It is unclear from the materials describing this study whether the results refer to the entire sample of 2400 respondents or one of the two sub-samples (a representative national sample and an over-sample of individuals living along one of four possible routes for transporting spent fuel to Yucca Mountain).

amplification of even a small traffic incident could result in a double digit drop in the number of visitors such as what occurred in Florida after several German tourists were killed. ... Gaming executives described the potential impact of a serious accident on their industry as crippling, devastating and “Chernobyl” like (UER, 2001b, p. 15).

This concern over nuclear-waste impacts has led a number of visitor-industry associations to take official stands in opposition to building a repository at Yucca Mountain. The first of these pronouncements came from the Nevada Resort Association (NRA) which passed an anti-repository resolution in 1991 (Morrison, 1991). According to the NRA (1991),

The establishment of a high-level nuclear waste repository is inconsistent with the positive image the state seeks to present to the world. ... [A]ny news stories about the repository and associated transportation of radioactive materials to it could cause special damage to the reputation enjoyed by Las Vegas and the success of its tourism promotion efforts.

For nine years, the NRA resolution served as the only public statement from the visitor industry regarding their sentiments toward the proposed repository. This low profile was in many ways out of character for the often flamboyant individuals who own and manage Las Vegas’s casinos and resorts. (It is possible that the industry was reluctant to raise an issue that might deter visitors or investors.) However, during the latter portion of 2000, Stephen Cloobek, president of Diamond Resorts International in Las Vegas, spearheaded a vocal, highly visible campaign dedicated to making the case that a repository at Yucca Mountain could have serious impacts on the visitor economy (German, 2001). Cloobek attracted a coalition of casino executives, civic leaders and elected officials (referred to as “Save Nevada”) willing to invest time and money into creating an organized opposition to DOE.

Following Cloobek’s lead, many other executives from the gaming and visitor industry became more actively engaged in opposing the repository. The Las Vegas Chamber of

Commerce voted January 31, 2001 to oppose the repository. According to the Chamber's resolution, "One accident involving the transportation of nuclear waste, no matter how minor, could create fears and hysteria among the general public and cause fewer tourists to travel to Southern Nevada, even if scientists determine these fears are unfounded" (Strow, 2001).

The Las Vegas Convention and Visitor Authority quickly followed suit on February 13, 2001. After little debate and no opposition, the LVCVA's board voted unanimously to approve a resolution "opposing the use of Yucca Mountain as a nuclear waste repository." According to LVCVA president Manny Cortez, "It is important that we as a convention authority make this statement. Tourism and travel is a very sensitive industry. If, God forbid, something happens as a result of that waste, it would create adverse publicity and hurt tourism" (Strow, 2001).

This reaction from the Las Vegas visitor industry mirrors the response from businesses in other parts of the country when nuclear-waste facilities have been proposed near their communities. For example, the executive director of the Ruidoso Valley Chamber of Commerce was deeply opposed to the construction of an MRS on the nearby Mescalero Apache reservation:

I don't fault the Mescaleros for wanting to improve their standard of life. But this is such a scary proposition. Our economy is 99.9 percent based on tourism. It's not a comfortable mix. I don't quite trust the powers that be who keep saying that it's safe (Johnson, 1995).

Likewise, business owners in Santa Fe, New Mexico expressed opposition to the construction of the Waste Isolation Pilot Project (WIPP) in Carlsbad because of the potential impact of transporting the transuranic wastes through Santa Fe:

This is more than an environmental issue. It's a health and safety issue. It's a tourism and economic issue. An accident has the tendency to turn tourist towns into ghost towns (Roberts, 1991).

Investors

Although those individuals and businesses with the most to lose from downturns in tourism express strong concerns about the disposal and transportation of nuclear waste, it is possible that they are being “hyper-sensitive” to this risk. Metz (1992) suggested as much in arguing that there is only negligible concern over repository-induced impacts to the visitor economy among more “rational” economic decision makers. In particular, Metz pointed to the continuing boom in hotel construction as an indication that **investors** downplay any possible consequences of a repository on the Las Vegas visitor industry.

Additional capital commitments to remodel and expand existing casino/hotel establishments and to develop new, large-scale theme facilities continue to be supported by the investment community... The opinions of investors, as voiced by their continuing investment in the Nevada economy, reveal that they have evidently discounted predictions of possible adverse economic impacts from a repository and demonstrate a belief that southern Nevada will remain a premier vacation or convention destination for those seeking full-casino gaming, recreation, resort, entertainment, and ‘must see’ attractions (Metz, 1992, p. 38).

Metz goes on to suggest that the investment community has considered and rejected the contention that a repository at Yucca Mountain would lead visitors to avoid Las Vegas. On the other hand, he also acknowledges that the continued willingness of investors to back visitor-dependent businesses in Las Vegas might reflect a number of alternative explanations. For example, investors may believe that either (a) the repository ultimately will not be located in Nevada, or (b) satisfactory payback would be received before the development of the repository or the occurrence of repository-related accidents. Both of these alternative explanations appear highly plausible. This is particularly evident in retrospect. In the nine years since Metz conducted his study, there remains a distinct possibility that a repository will never be built at

Yucca Mountain. And given the delays in site characterization and DOE decision making, there was certainly enough time for investors to recoup a satisfactory payback. In fact, in retrospect, investing in Las Vegas casinos in 1991 or 1992 was not only a “rational” economic decision, but also a lucrative one.

A subsequent study by Urban Environment Research (2001a) directly tested Metz’s assertion that investors minimize the economic risk posed by a high-level nuclear waste repository. Loan officers from 15 Clark County banks were presented with a series of three repository-related scenarios and asked to estimate the impact that these scenarios would have on the value of commercial, industrial and residential properties. Under a scenario with no transportation accidents, the lenders estimated (on average) that commercial properties located within 1 mile of HLNW-transportation corridors would depreciate only negligibly – by 0.6%. However, under a transportation-accident scenario, the diminution in property values becomes notable: 4.0% in the case of an accident with no radiation release and 22.0% in the case of an accident where the cask is breached and radiation is released into the environment. These results suggest that investors do take into account the possible economic impacts of a HLNW repository, but they discount these risks if there is no evidence of high-profile incidents.

Taking the Metz (1992) and UER (2001a) studies together, it appears that investors are not quite so quick as casino executives to believe that a repository at Yucca Mountain will *inevitably* lead to visitor losses for Las Vegas. On the other hand, investors are quick to sell off their interest in commercial properties when there is any evidence of radioactive contamination nearby (Hunsperger, 2001). This suggests that investors currently have a “wait-and-see” attitude regarding the potential for visitor losses. If and when the repository leads to any events that diminish the image or safety of Las Vegas as a visitor destination, the market can be counted on

to respond in short order. In the meantime, it is probably safe to say that investors have adopted a tentative, "fair-weather" position on the argument that seems so plausible to Nevada's elected officials and visitor industry.

FIRST-ORDER TESTS OF VISITOR IMPACTS

The previous section indicated that there is at least some “face validity” to the argument that a repository at Yucca Mountain could lead to significant losses to the Las Vegas visitor economy (in that a number of public officials and business leaders have argued in favor of the possibility). On the other hand, it is not enough to simply raise the argument or present a theory that “explains” how such effects could occur. NWPO has played a leading role in supporting empirical studies that test the actual validity of the argument (White et al., 1994). In this section, we consider two distinct sets of studies that examine whether or not a repository at Yucca Mountain might lead visitors to avoid southern Nevada: self-reports of intended behavior and a review of “analogous facilities.”

What Do People Say They Would Do if the Repository Were Built?

The seemingly most straightforward approach to predicting whether a repository would reduce the number of visitors to Nevada is to ask potential visitors to anticipate their behavior. NWPO sponsored a series of studies that asked target decision makers whether a repository at Yucca Mountain would have an impact on behavior such as planning conventions, attending conventions, vacationing, outmigration, and business location (e.g., Kunreuther, Easterling & Kleindorfer, 1988; Kunreuther, Desvousges & Slovic, 1988; Krannich & Little, 1989; Greenwood, McClelland & Schulze, 1988; Mushkatel, Nigg & Pijawka, 1989; Easterling & Kunreuther, 1993). Intended-behavior surveys, common in marketing research, present respondents with some sort of scenario (e.g., a new product on the market) and ask them to predict how they would respond, in either a deterministic sense (yes/no) or by reporting a probability of emitting a particular behavior (Fishbein & Ajzen, 1975; Pickering & Isherwood,

1974; Morrison, 1979; Sheppard, Hartwick & Warshaw, 1988).

A pair of public opinion surveys conducted in 1987 by Kunreuther, Desvousges and Slovic (1988) provided the first test of whether an HLNW repository could lead people to avoid places as far away as Las Vegas. These surveys, one of Nevada residents and one of persons living in other states, contained a set of questions regarding changes in behavior (visiting on vacation, attending a convention, and locating a new business) following the introduction of a repository “near” the target community (either 50 or 100 miles away, depending upon the experimental condition). As shown in Table 3, the majority of each sample (57% of the national sample, 51% of the Nevada sample) indicated that a repository would make it “less desirable” to vacation in a place located 100 miles away (about the distance between Yucca Mountain and Las Vegas). According to respondents, convention attendance would be somewhat less influenced by the repository (43% of each sample).

Table 3
Reported Effect of a Repository on the “Desirability” of Visiting Nearby Places
(1987 Surveys)

BEHAVIOR	Distance from repository	National Sample (n=1201)	Nevada Sample (n=804)
Visiting on vacation	50 miles	61.3%	60.8%
	100 miles	57.0%	51.3%
Attending a convention	50 miles	47.5%	50.3%
	100 miles	42.7%	43.1%

Note: The figures in the table indicate the percentage of respondents who reported that a high-level nuclear repository would make it “less desirable” to visit a location X miles away (with X=50 or 100 miles, depending on the specific question asked the respondent).

Source: Data are from the 1987 surveys reported originally in Kunreuther, Desvousges and Slovic (1988). These analyses were conducted subsequently by Easterling (1995).

The usefulness of the Kunreuther, Desvousges and Slovic (1988) study is limited by the wording of the behavioral-intent question: rather than asking about expected changes in

behavior, the survey asked whether the repository would make a place “less desirable” as far as vacationing and conventions. It might be argued that this approach to questioning produced over-estimates of avoidance behavior since we often end up doing things even when they are not completely “desirable.”

This limitation was remedied in a subsequent survey of convention attendees (Easterling & Kuneuther, 1993). This survey also asked about a range of noxious facilities in order to test whether the proposed HLNW repository has a special potential for producing avoidance behavior. The convention attendees survey sampled 600 individuals who were members of one of six professional associations⁶ and who regularly attended that association’s annual meetings. The telephone survey included a long series of questions about the process that one goes through in deciding whether or not to attend a convention. At the end of the survey, respondents were told to assume that they had made a tentative decision to attend a convention, and then found out that a particular facility was located 100 miles away from the host city. Five different facilities were specified: a prison, a nuclear reactor, a hazardous waste incinerator, a low-level radioactive waste repository, and a high-level nuclear waste repository. For each facility, respondents reported whether they would “definitely attend,” “probably attend,” “probably not attend,” or “definitely not attend.”

The results from these questions are shown in Table 4. Little effect is reported for the more common facilities: only 1 percent of the sample indicated they probably or definitely

⁶ The six organizations included in the survey were: American Frozen Food Institute, American Orthodontic Society, Clinical Laboratory Management Association, Joint Council on Economic Education, National Purchasing Institute, and United Bus Owners of America. These organizations met the following criteria: (a) the organization is national in scope, (b) it holds one convention (not a trade show) each year, (c) the previous four conventions (1986 through 1989) were held in four separate cities, (d) one of these meetings was held in Las Vegas, (e) the organization was willing to provide us with its membership list. Of the 11 organizations that met all five of these criteria, we chose the set of six that we felt would maximize the diversity of our sample.

would not attend if a *prison* were within 100 miles of the host city, while 3 percent reported they would not attend with a *nuclear power reactor*. The three waste disposal facilities elicited stronger reactions. The HLNW repository provoked the most extreme response: 7 percent reported that they “definitely would not attend” and another 16 percent reported they “probably would not attend” (i.e., 23 percent either “probably” or “definitely” would not attend). These data indicate that the HLNW repository poses a much stronger risk of visitor impacts than is true for existing facilities.

Table 4
Willingness to Attend a Meeting if a Repository was Located 100 Miles Away

FACILITY	Definitely Would Not Attend	Probably Would Not Attend	Probably Would Attend	Definitely Would Attend
High-Level Nuclear Waste Repository	6.8%	16.1%	28.0%	49.1%
Low-Level Radioactive Waste Repository	2.9%	7.1%	28.8%	61.3%
Hazardous Waste Incinerator	1.2%	5.2%	27.9%	65.7%
Nuclear Reactor	1.0%	2.2%	26.2%	70.6%
Prison	0.5%	0.8%	20.4%	78.3%

Note: Subjects were told to assume that this was a meeting they had decided to attend prior to learning of the facility.

Source: Easterling & Kunreuther (1993).

Approximately the same level of avoidance was predicted by a *convention planners* in a 1988 survey (Kunreuther, Easterling & Kleindorfer, 1988). Each of the planners included in this study had selected Las Vegas for a meeting in the past. As part of a longer interview, the planners were provided a description of the proposed repository and asked to reconsider their

selection of Las Vegas under the assumption that the repository had recently opened at Yucca Mountain. In particular, the respondents were asked if Las Vegas was still their first choice, and if not which cities would now rank ahead of Las Vegas. Among the 153 planners, 32 percent indicated that they would lower their ranking of Las Vegas if the repository were present. Moreover, 8 percent reported that they “would no longer consider Las Vegas as an option.”

In addition to asking respondents to express their preference for Las Vegas under a “nondescript” repository scenario, the convention planner survey also elicited responses under a series of scenarios involving accidents of varying levels of severity. Each scenario was associated with either “amplified” or “dampened” media attention. Table 5 indicates that under all scenarios, at least 30 percent of the planners lowered their ranking of Las Vegas compared to their initial ranking for the target meeting. Under Scenario 6 (a collision between a truck carrying HLNW and gravel truck which dispersed radiation over a half-mile area, 40 miles from Las Vegas), 64 percent of the planners indicated that they would lower their ranking of Las Vegas and 31 percent reported that they would “no longer consider Las Vegas for the meeting.” In the most extreme scenario (where the repository was plagued by recurrent accidents and safety lapses, accompanied by amplified media coverage), 75 percent of the sample lowered their ranking of Las Vegas and 43 percent indicated that they “would no longer consider Las Vegas” for the meeting. To the extent that such a scenario is plausible, these figures suggest that close to half of convention planners who would otherwise choose Las Vegas to host their meetings would go elsewhere.

Table 5
Changes in Planners' Ranking of Las Vegas Under Repository Scenarios

SCENARIO	MEDIA ATTENTION	Sample size	% who lower their Ranking of Las Vegas	% who would no longer consider Las Vegas
1. Opening of repository	Dampened	153	32.0%	7.8%
2. Benign 10-year history	Dampened	75	30.7%	4.0%
	Amplified	78	30.8%	9.0%
3. Minor accident on site	Dampened	75	40.0%	6.7%
	Amplified	78	46.2%	14.1%
4. Minor transportation accident	Dampened	78	38.5%	12.8%
	Amplified	75	49.3%	21.3%
5. Moderate accident on site	Dampened	78	41.0%	14.1%
	Amplified	75	49.3%	21.3%
6. Moderate transport accident	Dampened	75	53.3%	32.0%
	Amplified	78	64.1%	30.8%
7. Report on recurrent accidents and new risks	Dampened	78	55.1%	32.1%
	Amplified	75	74.6%	42.7%

Source: Kunreuther, Easterling & Kleindorfer (1988).

Predictions of avoidance behavior have also been found in studies that non-NWPO researchers have conducted on nuclear waste. For example, Fox et al. (1985) conducted a study to see if vacation behavior might be influenced by the presence of an MRS facility at Oak Ridge, Tennessee. In a sample of 306 persons living outside Tennessee, 47 percent indicated they would

change their vacation plans if they learned that their destination was located "near" an MRS facility.

And in an especially interesting case, Jenkins-Smith and Silva (1996) working under contract for DOE found that respondents reported they would change their vacation plans in response to the transportation of HLNW. In the absence of any reference to nuclear waste, 7.7 percent of their sample said that it was "very likely" that they would vacation in Nevada in the next five years. This figure dropped to 6.0 percent when that question was re-asked with a qualification: "If you knew that the government was going to transport spent nuclear fuel from nuclear power plants through Nevada, how likely would you be to take a vacation in Nevada in the next five years?" This decrease – from 7.7 percent of the sample to 6.0 percent of the sample – equates to a 22 percent reduction in the number of respondents in the category of "very likely" visitors to Nevada.

In sum, all the studies employing the "intended behavior" methodology have found evidence that people will change their behavior in the presence of a repository. The size of that effect ranges anywhere from 7 percent of the sample to 75 percent of the sample, depending on the methodology, the scenario and the threshold we employ in determining what constitutes avoidance behavior (e.g., "probably would not attend" versus "definitely would not attend").

On the other hand, intended-behavior studies are subject to much criticism. Certainly, DOE's researchers have criticized these studies when they are presented as evidence for visitor impacts (Bassett & Hemphill, 1991; Metz, 1994; Jenkins-Smith & Silva, 1996). More generally, it is important to acknowledge that the link between stated intent and subsequent behavior is far from perfect (Fishbein & Ajzen, 1975; Pickering & Isherwood, 1974; Morrison, 1979; Sheppard, Hartwick & Warshaw, 1988; Jamieson & Bass, 1989; Easterling, Morwitz & Kunreuther, 1990).

One of the major limitations in using intended-behavior studies to predict actual avoidance behavior is the heightened salience afforded to the repository.⁷ The NWPO surveys purposely made the repository salient to the respondent before asking about intended behavior, whereas in practice the individual may make a decision without being presented with any cues that would call his/her attention to the fact that a repository is “near” the vacation destination.

This issue is particularly relevant when drawing inferences from “mild” scenarios. If, for example, the repository had been operating for 10 years without any notable incidents, it is unlikely that a potential visitor would have recently read any newspaper articles about the repository. Thus, the decision task facing respondents in the convention planners survey (where they were presented with a mock newspaper article indicating a benign 10-year history) is unlikely to correspond to the actual decision task faced by convention planners if this scenario were to come to pass. Thus, the convention planners survey would be a biased instrument for estimating the degree to which planners would avoid Las Vegas under a benign scenario.

On the other hand, there is no systematic bias when it comes to the more severe scenarios tested in the convention planners survey. Incidents involving high-level nuclear waste (particularly transportation accidents that occur in the vicinity of Las Vegas) are likely to receive significant media attention if and when they occur. Thus, the decision task facing the survey respondents under scenarios 4, 5, 6 and 7 will be quite comparable to the decision task that planners will actually face if these scenarios come to pass.

For example, consider Scenario 6 in which a “moderate transportation accident” occurs (a collision between a truck carrying HLNW and gravel truck which dispersed radiation over a half-

⁷ In addition, the intended-behavior studies are limited in their ability to predict actual avoidance behavior because of the long latency between the surveys and the opening of the repository. It is possible that the public will become either more or less averse to nuclear waste (as well as nuclear technology more generally) with the passage of time.

mile area, 40 miles from Las Vegas). The scenario was described to the respondents in the form of a four-paragraph news story. If such an event did occur a week before a convention planner decided whether or not to hold a meeting in Las Vegas, it is highly likely that this event would come to mind as the decision was being made. Thus, the responses observed in the study are likely to be a fairly accurate representation of the actual behavior the planners would show if the scenario actually occurred.⁸

⁸ The issue of methodological bias is more complex in those studies that fail to specify a specific scenario for the repository (e.g., Easterling & Kunreuther, 1993; Kunreuther, Desvousges & Slovic, 1988; Fox et al., 1985; Jenkins-Smith & Silva, 1996). In each of these studies, respondents were asked whether the presence of a HLNW repository or the transportation of spent nuclear fuel would change their willingness or desire to visit nearby places. However, the interviewer provided no specific information as to whether or not any incidents had occurred involving the transport or storage of nuclear waste.

These studies will likely overstate the level of loss that will actually occur under benign repository scenarios – because the repository is *overemphasized* relative to what would occur in real life. For example, it is highly unlikely that 47 percent of potential visitors would avoid Tennessee if an MRS opened at Oak Ridge and there were no events to bring the facility into the news.

On the other hand, these studies will likely understate the level of loss that would actually occur if the repository is plagued with notable accidents – because the scenario descriptions used in the study did not explicitly include those events.

The major limitation of these studies is that the intended-behavior questions were not at all specific about how the repository had been operating, which allowed the respondents to draw their own idiosyncratic set of inferences. It is unclear whether the respondents who reported that they would avoid a location near the repository were more sensitive than those who reported the repository would have no effect, or alternatively whether these respondents imposed harsher assumptions about the repository's history of accidents and radiation releases.

What Has Happened with Repository-Like Facilities in the Past?

In addition to these studies of intended behavior, historical experience can provide even more concrete evidence for repository-induced impacts to the visitor economy. As such, NWPO sponsored a series of studies that studied the actual socioeconomic impact of facilities that are “analogous” to the proposed repository. The analogous-facility approach is, of course, limited by the fact that a geologic repository for high-level nuclear waste does not currently exist in the United States. Moreover, the radioactive-waste disposal/storage facilities that do exist (e.g., for low-level radioactive waste) are not located near major tourist destinations.

Despite these limitations, the examination of analogous facilities has produced evidence supporting the possibility that a repository would lead to major losses to the visitor economy. The March 1979 accident at the Three Mile Island (TMI) nuclear plant near Harrisburg, Pennsylvania was one of the first documented cases to demonstrate the potential of radiation events to influence visitor behavior. The near-meltdown of the reactor core transfixed the public, although only a small amount of radiation actually entered the environment. A study of TMI's economic impacts identified \$5 million in visitor losses (including the cancellation of the National Hardware Dealers' spring convention scheduled for Harrisburg) in the 30 days following the accident (Pennsylvania Governor's Office on Policy and Planning, 1980). However, tourism and visitation rebounded to their pre-TMI levels by the following year (Himmelberger, Ogneva-Himmelberger & Baughman, 1993). This is not surprising given that it was widely reported that actual releases of radiation into the environment were relatively minor.

More extreme visitor impacts have been observed in cases that more clearly involve the release of radiation into the environment and/or radiation-induced health effects. One of the most vivid of these was an incident of contamination that occurred in Goiania, Brazil during the

fall of 1987 (Pettersson, 1988; Brooke, 1995). The release of radiation occurred when two men cut into a discarded radiotherapy machine and exposed 100 grams of cesium-137. Children playing in the junkyard were attracted to the glowing material and passed it among themselves and their families. Through ingestion and physical contact, 129 individuals were contaminated, of whom 50 were hospitalized and 7 died. This event sparked fears throughout Brazil, with severe economic consequences. Hotel occupancy in the city dropped by about 40 percent for the six weeks following the accident. Scheduled conventions for General Motors, the Corrides Stock Car Association, Comansu Tractors, and the Regional Medical Association were all canceled. In addition, residents of Goiania were denied access to planes, buses, and hotels throughout the rest of Brazil; cars with Goiania license plates were stoned; and local agricultural products would not sell. The impacts from this event persisted in an extreme form for about a year, dissipating as it became clear that the threat of contamination had abated (Brooke, 1995).

On the Normandy Coast of France, the incident that prompted a decline in tourism was not a specific radiation release, but rather the release of a scientific report suggesting that local residents were contracting leukemia at higher-than-expected rates because of a local nuclear facility. A report appearing in the *British Medical Journal* in January 1997 identified the Hague nuclear fuel processing plant as a suspect in 27 cases of leukemia found among young persons living near the facility. Moreover, the researchers concluded that, "Our main finding was that the use of local beaches by children and mothers was associated with the development among the children." The report was highly publicized throughout Europe by newspapers, television programs and materials distributed by Greenpeace. According to the mayor of Beaumont, the incident has been "a catastrophe" for the area's reputation. Correspondingly, "when summer arrived, campers and hikers stayed away" (Whitney, 1997).

Urban Environmental Research (2001c) reports two additional case studies in which incidents at nuclear power plants have led to losses in visitation to nearby destinations. An accident at the Tokaimura power plant in Ibaraki Prefecture, Japan produced immediate and dramatic impacts to the local tourism sector. Local hotels, inns and restaurants suffered a loss of 1.47 billion yen in revenue within the first month and one hotel filed for bankruptcy. The second case reported by UER (2001c) involves the Dounreay nuclear power plant in Scotland, which has released radioactive contaminants that have appeared in the sand on local beaches. A local resort owner has filed suit against the United Kingdom's Atomic Energy Authority to gain compensation for lost business.

Together, these case studies provide evidence that nuclear facilities and incidents involving the release of radiation have indeed produced visitor impacts in the past. However, Metz (1994, 1996) has objected to this line of research, arguing that these case studies are highly selective and do not reflect the consequences of most nuclear facilities most of the time. In order to present a counter view, Metz (1996) analyzed the economic effects associated with a number of facilities within the DOE Nuclear Weapons Complex — facilities he regarded to be similar to the proposed HLNW repository in a number of important respects. He concluded that these facilities had not produced any discernible impacts to the visitor economy of nearby communities:

Tourism and recreational activities continue to grow in the vicinity of Weapons Complex facilities. New mega-resorts are being constructed in Las Vegas, 65 miles from NTS, and more are planned as the City seeks to promote a revised image as a family resort. Many facilities are near flourishing vacation areas (e.g., Hilton Head, Tampa, Colorado Rockies, Great Smoky Mountains) and annual national tournament sports events (Masters at Augusta National). Many facilities have expanded visitor centers, offer site tours and provide special use permits for

conference centers (Metz, 1996, p. 190).

In making the case against visitor impacts, DOE officials and researchers often point to the Nevada Test Site (NTS), located just adjacent to Yucca Mountain. This facility, which was opened by the Atomic Energy Commission (AEC) in 1951, was the site of more than 700 nuclear-weapons explosions, many of which rattled windows in Las Vegas (Metz, 1992). These tests were conducted above ground until the passage of the Limited Test Ban Treaty in 1963, at which point testing moved below ground. The earlier tests released radiation into the atmosphere, and in many cases exposed downwind residents and observers to substantial radioactive fallout (Fradkin, 1989). Even when the tests were moved below ground, temblors could be felt as far away as Las Vegas, although radioactive contamination was confined largely to underground cavities. A moratorium on nuclear testing was instituted by President Clinton in 1993.

DOE officials have argued that the rapid growth that Las Vegas's visitor economy has experienced since 1951 implies that NTS has not deterred tourists and conventions. Indeed, there is some evidence that during the early years of nuclear testing, Las Vegas may have actually attracted tourists due to the novelty of atomic explosions (Titus, 1988), and there is even some talk among DOE of turning NTS into a tourist destination (Weiner, 1997). However, very little research has actually investigated the impact that NTS has had on Las Vegas's visitor economy, particularly over more recent time.⁹ More importantly, even if NTS has had only a

⁹ The convention planner survey by Kunreuther, Easterling, and Kleindorfer (1988) — conducted at a time when underground tests were still being conducted — suggests that NTS may have had a marginal impact on the decision to hold a convention in Las Vegas. Among a sample 153 meeting planners who had booked conventions in Las Vegas, 2 percent indicated that NTS was "very important" in influencing their decision of whether or not to hold a meeting in Las Vegas, while another 3 percent reported that NTS was "moderately important." However, this survey was highly selective in that it sampled only planners who had scheduled a meeting in Las Vegas (and thus had at least a somewhat favorable opinion of the city). It is conceivable that planners outside the sampled population were more likely to avoid Las Vegas in response to NTS.

minimal effect on the visitor economy of *Las Vegas*, this does not necessarily mean that every community has been spared. For example, St. George, Utah, which received major doses of radioactive fallout during the 1950s, suffered a drop in its tourism and convention trade when the increased incidence of leukemia in the area was publicized (Fradkin, 1989).

IDENTIFYING THE CONDITIONS THAT PRODUCE VISITOR LOSSES

Looking across the various analogous cases reviewed above, it is clear that there are some instances in which visitors have avoided areas near nuclear facilities. On the other hand, it also appears from Metz (1996) that there are many instances in which nuclear facilities have not led to any discernible impacts to the visitor industry of nearby communities. These mixed results make it difficult to answer, in any definitive sense, the main question guiding this report, “Will a repository at Yucca Mountain produce losses to the southern Nevada visitor economy?” The correct answer is: The plausibility of visitor impacts will depend on what events actually occur if and when the repository is built.

We can be quite confident in concluding that visitors will avoid Las Vegas if the repository is accompanied by “sufficiently severe” scenarios. This conclusion obviously begs the question of what constitutes a “sufficiently severe” scenario. In this section, we attach some specificity to the notion of “sufficiently severe.” The following section then considers the question of how much impact one might expect under scenarios that qualify as “severe.”

Risk, Negative Image and/or Stigma

The three theories of visitor impact cited earlier in the report provide a good deal of guidance in predicting the types of repository-related events that would cause individuals to avoid visiting southern Nevada. In particular, according to these theories, Nevada would experience visitor losses if the repository leads potential visitors to either:

- a) believe that there is a heightened health risk associated with spending time in southern Nevada,
- b) diminish the image they hold of Las Vegas and/or Nevada, or

c) feel an imperative to avoid Las Vegas and/or Nevada out of a sense of stigmatization.

After 15 years of NWPO-supported research, there is plenty of evidence to support the proposition that visitor impacts will occur if one or more of these conditions occurs. In particular, studies by Slovic et al. (1991), Easterling and Kunreuther (1993); and Jenkins-Smith (1994) have each found that an individual's propensity to visit a particular location is predicted by the "image score" and/or perceived risk that the person associates with the place. In other words, we know that if an individual comes to regard southern Nevada as sufficiently risky or associates sufficiently noxious imagery with the area, that person will avoid coming for a visit. The question then becomes, "What sorts of events will produce strong levels of perceived risk or negative imagery among people who would otherwise visit southern Nevada?"

Historical Examples of Sufficiently Risky or Noxious Events

Summarizing the review of analogous cases presented earlier, we can conclude that the following radiation-related events were "potent" enough to influence potential visitors' perception of risk or imagery of nearby communities:

- the 1979 accident at the Three Mile Island nuclear power plant in Pennsylvania
- the 1988 contamination episode in Goiania, Brazil
- the 1997 scientific report linking an elevated incidence of leukemia to the Hague nuclear-fuel reprocessing plant on the Normandy Coast of France
- the 1999 accident at the Tokaimura nuclear power plant in Japan
- reports that radioactive particles from the Dounreay nuclear power plant have contaminated the beach in Caithness, Scotland
- "Shot Harry," the 1953 atomic test that spread radioactive fallout over St. George, Utah.

These cases strongly suggest that overt, publicized radiation releases, particularly those that lead to identifiable health effects, will trigger drops in visitation. This pattern of results has strong implications for predicting the conditions under which a repository at Yucca Mountain could impact the tourism of southern Nevada. We can gain additional insight by considering non-nuclear cases in which visitors avoided an area out of a sense that the health risks were too high and/or the image of the place was too negative.

September 11 Attacks

The sensitivity of the visitor economy to perceptions of risk has become vividly and painfully clear in the aftermath of the September 11, 2001 terrorist attacks on New York City and Washington, DC. The suicide flights into the World Trade Center appears to have been designed to send a signal that it is not safe for Americans to fly nor to spend time in New York City. The massive losses incurred by the airlines and hotels across the country are a testament to the effectiveness with which this message has been received by the traveling public.

By virtue of its location at “ground zero,” New York City has suffered a disproportionate burden of these visitor impacts. A week after the attacks, hotel occupancy rates were at approximately 20 percent, compared to an average rate of 84 percent (Bagli, 2001). Ian Schrager, the chairman of Ian Schrager Hotels, reported that:

We’re being decimated... People have been spooked by this. I’ve never seen a drop in occupancy like what happened after the attack (Bagli, 2001).

Even when people began to travel again, they continued to avoid New York. A month after the attacks, hotel occupancy was still 45 percent lower than normal (Associated Press, 2001). The losses extend well beyond the hotel sector. Restaurants also saw a huge drop in volume. In addition, four Broadway shows announced that they would close because of a lack of

attendance and six others were reportedly in danger of closing (Bagli, 2001). According to the New York City Tourist and Convention Bureau, visitor spending was down by \$324 million during the six weeks following September 11 (Sharkey, 2001).

By December, visitors had begun to return to New York: hotel occupancy was 70 percent compared to 78 percent a year earlier. However, this rebound required deep discounts on the part of hotels, restaurants and Broadway shows. In addition, the city was still failing to attract air travelers, particularly international tourists (Burghart, 2001).

Although Las Vegas is 2500 miles away from New York City, the September 11 attacks still had major repercussions on the visitor economy there as well. In the initial aftermath of the attacks, occupancy rates at Las Vegas hotels dropped by 30 percent or more. A month after the attacks, 15,000 workers in the visitor economy had been laid off (Greenhouse, 2001).

Violence

Although the terrorist attacks are in a category by themselves in terms of provoking risk-induced losses to a community's visitor industry, there are many other examples of this dynamic. In certain instances, violent crime can be a potent deterrent to tourism. This effect was demonstrated in Miami in 1993 when nine tourists (four of them Germans) were murdered in southern Florida. Many of these murders occurred after the victims were carjacked or inadvertently detoured into a dangerous section of the city on their way out of the airport. Between 1993 and 1994, the city suffered a 57 percent drop in German visitors (from 370,100 to 158,200) and a 7 percent decline among all international tourists (Navarro, 1995).

In similar vein, visitors avoided New York City following a spate of murders in 1990, including the shooting of a Utah tourist who was trying to protect his parents from robbers on the

subway (Hays, 1990).

A slightly different example of violence-induced visitor losses occurred in Los Angeles in 1992 following the riots that occurred in response to the verdict in the Rodney King case. According to the Los Angeles Convention and Visitors Bureau, the city was expected to lose \$1.1 billion in tourism revenues in the summer following the riots (*Rochester Times-Union*, 1992).

Environmental Hazards

Violence is not the only stimulus that heightens the perceived risk associated with visiting a place. There are a number of documented cases in which pollution and environmental contamination have produced drops in visitation:

- The outbreak of foot and mouth disease in Britain in 2000-2001 was projected to produce an 80 percent decline in tourism revenues for the most impacted areas of Devon and Cumbria, as well as a 10 percent decline for the country as a whole (UER, 2001c).
- The appearance of medical waste on beaches in New Jersey and New York during the summer of 1988 led to visitor losses in the amount of \$1.5 billion (Lyall, 1991).
- The Bellevue-Stratford Hotel in Philadelphia lost so much business after the 1976 outbreak of Legionnaire's Disease that it was forced to change its name (Thomas and Morgan-Witts, 1982).

Visitors also avoid places following the occurrence of natural disasters, particularly disasters that suggest a lingering risk:

- San Francisco's Fisherman's Wharf was nearly deserted following the 1989 earthquake.
- The January 1995 earthquake in Kobe, Japan left the temples of nearby Kyoto relatively unscathed. However, "the real damage Kyoto was to its image as a pocket of serenity.

Since the earthquake, travelers have been staying away in droves” (*Denver Post*, 1995).

- The eruption of Mt. St. Helens led to a short-term 30% downturn in tourism within the region (Kreck, 1981).

Events that Confer Noxious Imagery Other than Risk

In addition to these instances where some event occurs suggesting that there is a heightened risk associated with a place, visitors have also been shown to avoid places that take on noxious imagery unrelated to danger. For example, Tacoma, Washington was long derided on account of its foul-smelling air — sulfur from the local pulp mills. The health risks associated with this particular contaminant were relatively minor, but the sheer unpleasantness of the odor (akin to rotten eggs) was enough to generate a common perception that there is “something wrong” and to induce people to avoid the city (Egan, 1988). Similarly, the Cadiz oil spill off the Brittany coast of France had a major effect on tourism (OECD, 1982),

Places also take on negative imagery based on the behavior and decisions of local elected officials. For example, Arizona was avoided by tourists and organizations planning national conventions during Evan Mecham’s controversial reign as governor, in which he overturned a referendum to establish a Martin Luther King holiday and make a number of racist comments in public speeches (Reinhold, 1990). This avoidance behavior did not stem from a formal “boycott” of the state (as was the case with the NAACP’s campaign against South Carolina’s flying of the Confederate flag), but rather a generalized sense that Arizona was not an “acceptable” place to visit.

A similar response occurred with regard to Philadelphia in the late 1980s. A survey of minority organizations conducted by the Minority Advisory Committee of the Philadelphia

Convention and Visitors Bureau found that Philadelphia is actively avoided by black meeting planners due to its poor image. The city's image among this group has been tarnished by factors such as the prevalence of trash and the 1985 MOVE incident, in which city police dropped a bomb on the headquarters of a radical organization, killing six adults and five children, and destroying an entire city block (Sahugan, 1988).

Summary

Taken together, these analogous cases demonstrate the wide range of events that can cause the imagery associated with a place to turn sour, leading to avoidance behavior on the part of tourists, convention delegates and convention planners. To the extent that the opening of a repository at Yucca Mountain allows “comparable” events to occur, southern Nevada is at least as likely to suffer visitor losses.

SCENARIOS THAT WILL PRODUCE VISITOR IMPACTS

The cumulative body of research reviewed here strongly supports the case that a repository at Yucca Mountain will produce visitor losses *if* the facility is accompanied by events that increase the perceived risk or negative imagery associated with Las Vegas or Nevada. The analogous cases cited above provide a great deal of guidance in predicting exactly what types of repository-related events would increase perceived risk or produce negative imagery, and thus lead to visitor impacts.

Rating the “Severity” of Repository Scenarios

There are literally thousands upon thousands of potential repository scenarios that

involve at least some probability of visitor losses. Some of these scenarios will be much more likely to produce impacts than others, and thus are more “potent” in influencing visitor behavior. How do we judge the “potency” of repository scenarios? The analogous cases, combined with the results of the convention planner study shown in Table 5, suggest that there are a number of key factors that can be used to “characterize” a scenario, which in effect allows us to assess its relative potency. In particular, the evidence indicates that a repository-related event would be more likely to impact the visitor economy of southern Nevada to the extent that the following conditions are true:

1. The event occurs close to Las Vegas
2. There is evidence of radioactive contamination to the environment
3. A large number of individuals suffer health effects as a result of the event
4. Those health effects are severe
5. Those health effects occur to “innocent” citizens, as opposed to emergency-response workers, truck drivers, or repository workers
6. The “effects” of the event (e.g., contamination) linger over time
7. The event has a high “signal” potential (i.e., it portends the occurrence of similar or worse events in the future)
8. The incident is one in a series of similar events

Each of these factors is important in determining how much the event adds to the health risks associated with visiting Las Vegas. The more that these conditions are satisfied, the greater reason a potential visitor has to think that they will experience a heightened risk if they visit Las Vegas.

In addition to these characteristics related to the nature of the repository event, the

potency of a scenario is strongly determined by the level and the nature of the media attention surrounding that event (Kasperson et al., 1988). News stories appearing in newspapers, on television, in magazines, or over the internet bring the event into the awareness of potential visitors, which is an obvious precondition to any avoidance behavior. Thus, "significant" media attention is a *necessary* (although not *sufficient*) condition for a repository event to produce visitor impacts.

In addition to disseminating information to large numbers of people, the media can increase the likelihood of visitor impacts by raising and reinforcing health concerns. At a minimum, this would involve simply describing the instances in which individuals had died or become ill. More extreme effects would result if the media carried multiple stories over an extended period of time describing the health effects in detail or by using language designed to instill fear in the reader (as has occurred with the recent media coverage of the anthrax-contaminated letters sent to government officials and the news media).

Repository events will be more potent triggers of visitor impacts if the media attention is more *intense* -- in terms of the number of publications across the country that cover the story, the length of those stories and the level of "emotional charge" contained in those stories. In addition, the longer that the media carry stories about the event and its sequelae, the greater the chance of the event settling into the public's image of Las Vegas. Especially for an accident involving the release of radiation within Clark County, consistent media attention would significantly increase the potency of the event as a deterrent to tourism and conventions. These stories would not only maintain the risk in the public's collective consciousness, but also reinforce the linkage between the risk and Las Vegas. On the other hand, even if an accident occurred at the Yucca Mountain site, it is possible that the resultant stories would focus heavily

on Las Vegas given the city's status as the closest population center.

A repository scenario that satisfies only a few of the conditions listed above may or may not produce visitor impacts. For example, it is unlikely that an accident at the repository site in which a worker was contaminated would, by itself, generate a great deal of attention or concern among individuals who are considering visiting Las Vegas. However, this incident would be likely to trigger visitor losses if the following conditions also occurred:

- the contamination of the worker stemmed from a flaw in the cask that was used to transport the wastes to the repository;
- “experts” suggested that this flaw was present throughout entire HLNW-transport system;
- the media publicized those concerns in a concerted manner; and
- the media also publicized the routes along which HLNW is transported, focusing specifically on highways in Clark County.

Likewise, the derailment of a coal train in Lincoln County might not register at all within the national press (and thus would not influence visitor behavior). However, if this accident seriously contradicted the safety assurances that DOE had proclaimed with regard to the transport of HLNW, an “interesting” news story might develop. Conceivably, if this accident led enough “credible” experts to raise concerns about the transportation risks, the story might reach a large number of potential visitors and influence their perceptions of the health risks associated with being in Nevada.

More generally, we need to pay attention to the combination of factors that characterize a repository scenario. Visitor impacts become more and more possible as more and more of the factors listed above fall into place (e.g., proximity to Las Vegas, health effects to citizens, evidence of contamination, high signal potential for future risk events, extended media

attention).

Repository Scenarios Destined to Produce Visitor Impacts

Although it is difficult to forecast the precise level of loss associated with specific repository scenarios, it is possible to identify the types of scenarios where visitor losses are “almost guaranteed” to occur. Events such as transportation accidents involving the release of radiation in or near Las Vegas fall within this category. More specifically, the analogous cases indicate that visitor impacts will be great if any of the following conditions occur:

1. There is an overt release of radiation that leads to death or illness among local residents or visitors;
2. The media presents information indicating that a) the area has been contaminated with some form of radioactive material and b) this contamination has not been contained;
3. A “cataclysmic” event occurs killing many local residents, and it appears possible that this event could occur again in the future; or
4. Tourists are killed in incidents where they could not control the risk.

Scenarios Where Visitor Impacts are Likely, but not Assured

Although only the most extreme scenarios are *guaranteed* to lead to visitor impacts, the likelihood of these impacts is still quite high under many “lesser” scenarios. For example, if a truck carrying spent fuel was involved in an accident in the vicinity of Las Vegas, it is very likely that some visitors would avoid the city, even if that accident did not involve a release of radiation into the environment. This conclusion assumes that such an accident would be widely

covered by the media, at least for a week or so following the event, and that this coverage would trigger fear or concern among some individuals who were in the process of deciding whether or not to go to Las Vegas for a vacation, a gambling trip or a convention. Because we need to make a set of assumptions in order to tell a story that leads to visitor losses, this scenario is in the category of “possible,” rather than “guaranteed” impacts.

More generally, the review of the analogous cases suggests that it is “likely” that southern Nevada would experience some degree of loss to its visitor economy under any of the following scenarios:

1. The release of a report suggesting that there is increased incidence of cancer among residents
2. A series of transportation accidents around the country which suggests that there is a special danger for Clark County (because so many shipments pass through there)
3. Media stories that describe the risk of terrorism with regard to the transport of nuclear waste
4. Repeated media stories that reinforce existing public perceptions regarding the repository (e.g., dangerous, immoral, contamination), and that link the facility to Las Vegas or Nevada.

The Extreme Low End: Scenarios Unlikely to Produce Visitor Impacts

The studies of analogous facilities are also useful in identifying scenarios that are unlikely to produce visitor impacts. Based on the experience of other nuclear facilities across the United States (Metz, 1996), it would appear that visitor impacts will not occur if the repository fades into the backdrop of the public’s consciousness once it becomes operational. This would

occur if (a) there are no major "risk events" associated with the repository and (b) the media stops paying attention to the facility once the siting conflict has been resolved.

The no-major-event, dampened-media-attention scenario appears as if it might be occurring with regard to WIPP in New Mexico now that the novelty of its opening has worn off. The national press did carry stories when the facility received its first shipment of transuranic waste (600 pounds of plutonium-contaminated clothing) from Los Alamos in March 1999 (Massey, 1999). However, as the protests have become fewer and farther between, the shipments have become less newsworthy.¹⁰ Without the media attention, WIPP offers little to discourage visitors from coming to New Mexico. To date, I am aware of no reports indicating that WIPP has had a discernible impact on the state's tourism or convention business. Of course, that could all change quickly if a truck carrying wastes to WIPP is involved in an accident in Denver, Albuquerque or somewhere else along I-25.

In the case of a HLNW repository at Yucca Mountain, a lack of media attention would leave the public's level of concern at levels that are near where they are today -- levels that do not seem high enough to translate into visitor losses. In particular, it appears from all the imagery studies conducted by the NWPO researchers that the repository does not naturally come to mind when people outside the state think of Las Vegas or Nevada as a place to visit (Slovic, Layman & Flynn, 1990). Moreover, only a few people report any nuclear imagery when presented with "Nevada" or "Las Vegas" as stimuli in a word association task, despite the long history of the Nevada Test Site. Two surveys of Phoenix residents (Slovic, Layman & Flynn, 1990; Jenkins-Smith, 1994) found that "Nevada" elicited nuclear and bomb-related imagery among 9-10 percent of respondents. A national survey found a much weaker link, presumably

¹⁰ The press in Denver did pay significant attention to WIPP three months later when the first shipment of waste left the Rocky Flats facility outside of town (Kelly, 1999).

because people outside the Western U.S. are less familiar with the Test Site (Slovic, Layman & Flynn, 1990).

Given that most potential visitors focus on very strong, vivid imagery related to gambling, entertainment and the desert when they think of southern Nevada (Slovic, Layman & Flynn, 1990; Easterling & Kunreuther, 1993), a repository would need to be a quite salient factor in order to enter into the image set and thus have an impact on visitor behavior. It is highly unlikely that repository-related risks or imagery would come to mind if there have been no news stories highlighting the facility. Moreover, for newspapers to cover the repository (at least in a way that reaches the general public outside of Nevada), something significant needs to occur. If, as DOE hopes, all the thousands and thousands of shipments actually do come off without a glitch, and if the repository system provides sufficient barriers to contain radiation within the mountain over the long run, the media attention might very well be quite dampened. However, a number of complex events must occur according to design over a very long period of time for this to be the true scenario.

It is important to stress that visitor impacts will be negligible only if the repository is a sufficiently benign addition to the mental landscape that people hold for Nevada. The many possible accident scenarios outlined earlier have the potential of changing how people think of the area. Only if all these scenarios can be *ruled out* is it legitimate to conclude that a repository at Yucca Mountain would not lead to visitor impacts for southern Nevada.

LEVELS OF IMPACT

The research reviewed above establishes a precedent for visitors avoiding an area in response to risk events, particularly events that involve the release of radiation. There is little doubt that the repository will produce visitor losses under a range of possible scenarios. However, the number of visitors who avoid Nevada will be greater or lesser depending on the severity and duration of the risk events that define the scenario. Thus, any assessment of how the repository will impact Nevada's visitor economy must rely on scenario-specific forecasts.¹¹

The most valid forecasts will be those that are conditioned on scenarios that are "comparable" to events that have actually occurred in the past. For example, consider the cases of Goiania, Brazil and Three Mile Island described above. In Goiania, 50 people were hospitalized and 7 died from exposure to cesium from a salvaged radiotherapy machine, while the accident at the Three Mile Island reactor resulted in only a "minor" release of radiation into the atmosphere. Despite the difference in the severity of radiation contamination, the two incidents produced very similar levels of visitor impact. Namely, in the months immediately following the two events, hotel occupancy rates dropped by 40-50 percent in nearby areas.

Interestingly, the September 11 attacks produced a very similar level of visitor loss in New York City. A month following the attack, hotel occupancy was off by 45 percent (the initial impact during the first week was even higher).

¹¹ From the beginning of NWPO's socioeconomic program, there has been a strong interest in generating *quantitative* estimates of the impacts that would occur if a repository were actually built and opened at Yucca Mountain. Such estimates would be in the form of the number of visitors lost, declines in visitor-generated revenues, job losses and/or other indicators of the impact to the local economy. It quickly became clear to the research team that any forecasts of visitor impacts would need to be *scenario-conditional*. There are too many uncertainties regarding the performance of the repository system to be able to predict -- in a deterministic sense -- how the public would react once it was built. However, even conditioning the forecasts on specific repository scenarios has proven to be quite a challenge in practice, largely because of the lack of a truly comparable "analogous facility" (Easterling, Morwitz & Kunreuther, 1991; PIC, 1994; Easterling, 1995).

Together, these results suggest that a high-profile incident suggestive of danger will have an effect on the visitation decisions of up to half the people who would otherwise visit a city. It also appears that this level of avoidance persists up until the public is convinced that the danger has passed. With the Three Mile Island accident, the losses abated when it became clear that the release had been confined to within the facility. With the attack on the World Trade Center, tourists began returning after the federal government began to take strong anti-terrorism measures, both at home and abroad. However, the incident in Goiania led to longer lasting visitor impacts because it took longer to determine the full extent of the contamination and to contain it.

Extending these experiences to the case of a HLNW repository, it would appear that southern Nevada could expect to suffer 40-50% declines in the case of a transportation accident that releases radioactive material in or near Las Vegas. This conclusion is reinforced by the convention planners survey, which found that a “moderate” transportation accident (Scenario 6) would cause 64 percent of planners would to lower their ranking of Las Vegas and 31 percent to avoid Las Vegas altogether. The duration of these losses would be highly dependent on whether or not there were any lasting effects of the accident – in terms of either persistent radioactive contamination or a lingering sense that more accidents could occur in the future.

In considering the impact of a repository on the Las Vegas visitor economy, it is important to recognize how many visitors correspond to each percentage-point drop in visitor volume. Compared to Goiania and central Pennsylvania, Las Vegas would lose a much higher **number** of visitors in response to a radiation event. For example, the cities of Harrisburg and Lancaster in Pennsylvania experienced a 50% decline in visitors following the accident at Three Mile Island, which translated into a \$5 million impact. If Las Vegas experienced a month-long

50% drop in tourists, this would amount to losing 1.5 million visitors and \$1.2 **billion** dollars in revenue (using the Las Vegas Convention and Visitor Authority's figures for 2000 as the base).

Moreover, if repository-related accidents lead to longer-lasting public concern, those losses quickly mount to much higher totals. For example, consider the case where a transportation accident produces a 50% decline the first month and then visitation gradually rebounds over the next 11 months -- so that one year after the event, visitor volume is back to its pre-event level. Under this pattern of visitor impact, the cumulative loss for the year would be 9 million visitors and \$8 billion in revenue.

With an even more extreme repository scenario, southern Nevada could experience even longer-lasting visitor losses. For example, a serious transportation accident within the city of Las Vegas could lead to a situation where nuclear-waste imagery and a sense of danger become more permanent features of the "image set" that people associate with the city. If public perceptions change in this manner, visitor losses would likely persist well into the future. Visitor volume would probably begin to climb again at some point in time, but it may take years to reach levels that Clark County has enjoyed in the absence of a repository. Certainly, the rate of increase in visitor volume would fall short of the 5.5% figure that Las Vegas has experienced over the past 30 years.

CONCLUSION

Since 1986, the Nevada Nuclear Waste Project Office has supported a comprehensive research program to understand the potential for a repository at Yucca Mountain to lead visitors to avoid coming to southern Nevada (Chalmers et al., 1993; Flynn et al., 1995; Nevada Agency on Nuclear Projects, 2000). This research program (which has resulted in over 200 technical reports and 100 publications in professional journals) has demonstrated that a large fraction of people predict that a repository would have a negative influence their willingness to visit a nearby area, particularly if the repository is accompanied by accidents that release radiation into the environment. These studies have also established the credibility of perceived risk and negative imagery as pathways through which visitor impacts could occur. The plausibility of impacts to the visitor economy was dramatically reinforced by the September 11 attacks. Economies that rely heavily on visitors to generate revenues can be quickly upended when an “unforeseen” incident raises the specter of danger.

Based on analogous cases where visitors have avoided areas following radiation releases, environmental contamination, violence or earthquakes, it is reasonable to conclude that southern Nevada could suffer a 30% drop in visitation following “moderate” repository-related accidents. More extreme incidents could easily lead to a 50% drop, possibly lingering well into the future.

With a visitor economy as substantial as Nevada’s, these declines represent devastating losses to income, property value and tax revenues. The cumulative impact following a transportation accident near the Strip could easily reach \$10 billion, which is substantially more than the \$7 billion that the United States has invested in the entire repository program over the past 20 years. This possibility imposes a huge risk on the one state that has been unlucky enough to draw the short straw in shouldering the country’s nuclear-waste burden.

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